

United States Patent Cobb

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[54] **HEATED CORONA CHARGING UNIT**

[72] Inventor: **Harold W. Cobb**, Acton, Mass.

[73] Assignee: **Dennison Manufacturing Company**, Framingham, Mass.

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[58] Field of Search 250/49.5 GC, 49.5 ZC, 49.5 TC;
317/262 A; 355/17

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Primary Examiner—William F. Lindquist

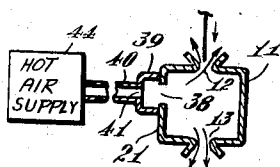
Attorney—Roberts, Cushman & Grover

[57]

ABSTRACT

A corona charging unit for use in an electro-photographic copier apparatus wherein such unit utilizes a heater mounted on or nearby such unit so as to raise the operating temperature thereof above its normal operating temperature so as to eliminate streaking in the visible image produced by such copier apparatus.

2 Claims, 5 Drawing Figures



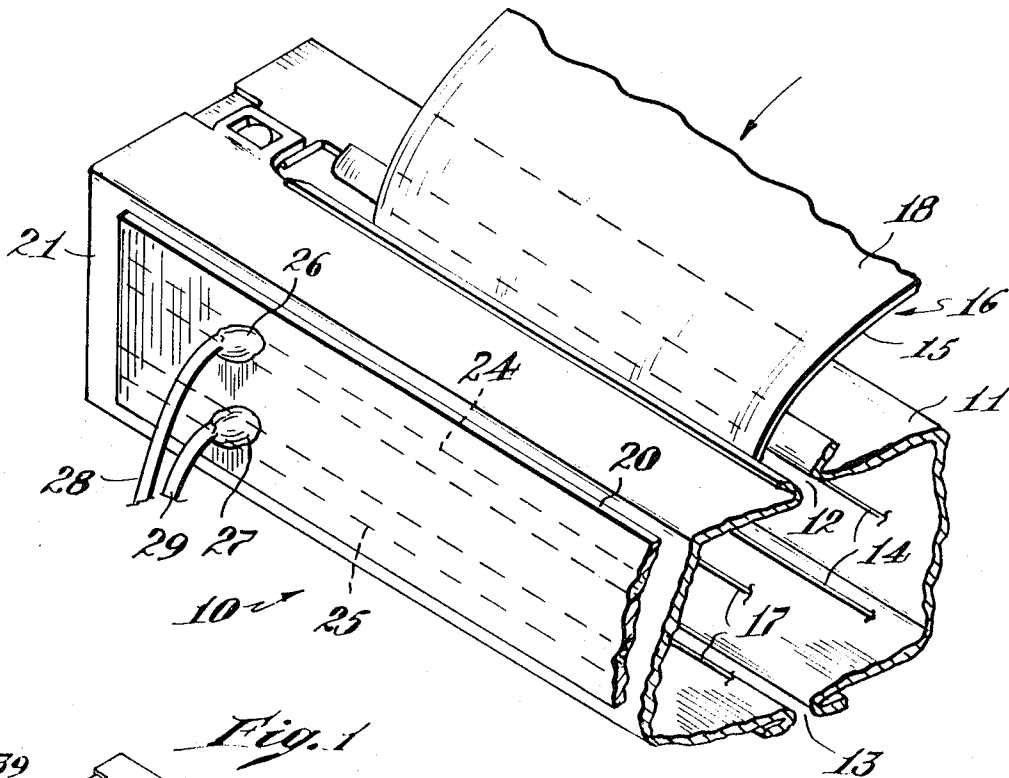


Fig. 1

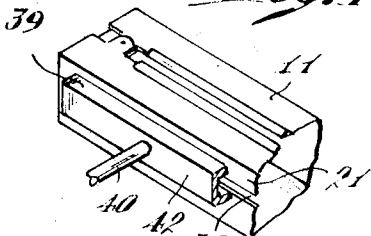


Fig. 4

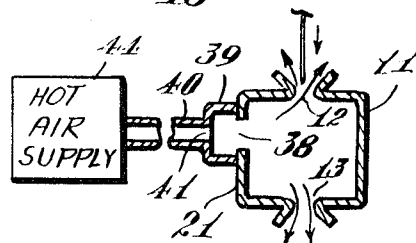


Fig. 5

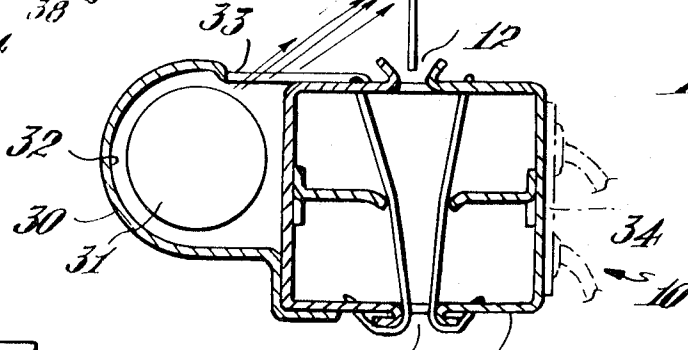


Fig. 2

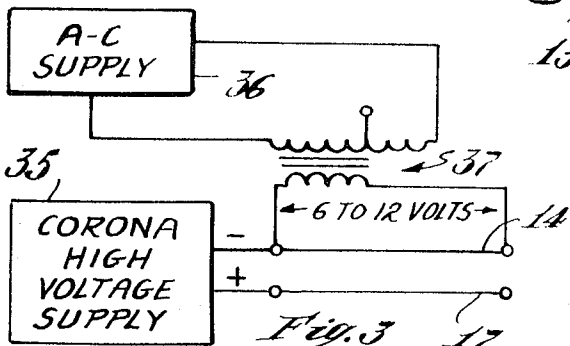


Fig. 3

Inventor
Harold W. Cobb
by Robert, Ashman & Son
Attorneys

HEATED CORONA CHARGING UNIT

This invention relates generally to copier apparatus and, more particularly to electrostatic copier apparatus utilizing a corona charging unit wherein said unit is heated above its normal operating temperature in order to eliminate streaking in the image produced during the copying operation of said apparatus.

In copier apparatus of the electrostatic type, such as utilize principles of electro-photography, a uniform electrostatic charge is applied to the surface of an electro-photographic plate and the charged plate is subsequently exposed to a pattern of light and shadow to discharge the light struck areas and produce a latent electrostatic image which can be appropriately developed to a visible image. In such apparatus the electrostatic charge is applied by an appropriate corona charging unit wherein the electro-photographic plate, which term includes, for example, a paper coated with a photoconductive insulating layer such as zinc oxide, is moved past the corona charging wires so that the appropriate charge is placed thereon.

In the use of such an apparatus it has sometimes been found that different areas on the same plate often become charged to different potentials. In some instances, some areas may remain completely uncharged after leaving the corona unit. The result of such irregularity in charging is to produce a streaky effect upon the image when it is subsequently developed, such effect being usually manifested by the presence of one or more white lines of varying widths along either part of or the entire length of the visible image. Such streakiness is obviously undesirable and attempts have been made in the past to avoid such affects through various techniques. For example, the prior art has suggested the use of a conductive grill in the form of a wire screen, for example, located between the corona wires and the photoconductive insulating layer in order to produce a more uniform charge on the insulating layer (U.S. Pat. No. 2,777,957 issued to L. E. Walkup on Jan. 15, 1957). Others have attempted to avoid streakiness by altering the operation of the developer unit in copier apparatus such as by applying toner material from a plurality of different directions across the surface of the latent image (U.S. Pat. No. 3,424,579 issued to A. Balint et al. on Jan. 28, 1969). Such techniques unduly complicate the structures of the units involved and have not found any appreciable acceptance in the art.

This invention, however, provides a simple and economical way to eliminate streakiness the operation of which has been found to be extremely effective even in instances where streakiness is known to be more pronounced, such as when the electro-photographic plate is subject to a pre-exposure light, that is, where the electro-photographic plate is exposed to light prior to the corona charging step. In accordance with the invention, the corona charging unit is heated to an elevated temperature above that at which it conventionally operates. The heating of the corona unit effectively eliminates substantially all streaking problems and can be embodied in a simple structural configuration as discussed in more detail below.

The invention and its operation can be described more easily with the aid of the accompanying drawings wherein

FIG. 1 is an isometric view with portions broken away of a corona charging unit utilizing one embodiment of the invention;

FIG. 2 is a cross-section view of a corona charging unit utilizing the invention, such unit having pre-exposure lamp and housing attached thereto;

FIG. 3 is a circuit diagram depicting an alternative embodiment of the invention;

FIG. 4 is an isometric view of a portion of a corona charging unit utilizing a further alternative embodiment of the invention; and

FIG. 5 is a lateral cross-section view of the alternative embodiment of FIG. 4.

With reference to FIG. 1 there is shown a corona charging unit 10 which, as is understood by those in the art, is mounted within a conventional copier apparatus (not shown) so as to electrically charge a photographic plate prior to its exposure

at an exposure station where a latent electrostatic image is to be formed.

Corona charging unit 10 includes a housing 11 having an upper slot 12 and a lower slot 13 through which the photoconductive plate is passed. In the apparatus described the photographic plate is in the form of a paper sheet 16 having a photoconductive insulative coating, such as zinc-oxide, on side 15 thereof. A first pair of corona charging wires 14 are mounted so as to be adjacent the coated side 15 of paper 16 as it passes through the charging unit. A second pair of corona charging wires 17 are mounted so as to be adjacent the back or uncoated side 18 of paper 16 as it passes therethrough. Corona wires 14 are connected to one terminal of a power supply (not shown) and corona wires 17 are connected to the opposite terminal thereof via appropriate connectors so as to supply a suitable high voltage across such wires.

In the embodiment shown in FIG. 1 a resistance heating element 20 is shown mounted on a side panel 21 of housing 11. In the particular embodiment shown, heating element 20 comprises a layer of conductive plastic material connected along its length on either side thereof by a pair of conductive bus bars 24 and 25 which are in turn connected at appropriate points 26 and 27 to a pair of wires 28 and 29 and thence to a heater power supply unit (not shown).

Although resistance heating element 20 is shown mounted on the side of the housing which is adjacent to the uncoated side of the paper as it passes through the charging unit, it is clear that such heating unit may be placed at some other suitable position (such as on the opposite side panel adjacent the coated side of the paper) so long as heat is supplied to raise the temperature of the overall corona unit 10. The form of the heating unit may be other than that shown in the figure so long as the desired heating effect is achieved.

It has been found that an appropriate heating is achieved if the temperature of the corona unit during operation is raised by about 15° F or more. For example, where a conventional corona charging unit operates at approximately 140° F during operation of the apparatus, a heating unit which raises the operating temperature along the length of such corona charging unit to approximately 160° F considerably reduces the streaking effects which may be encountered in normal operation.

Heating of the corona unit results in an increase in the level of corona current. In the particular embodiment mentioned above, where the temperature was raised from 140° to 160° F, it was found that the corona current increased about up to 20 percent an effect which increased the charging efficiency of the overall unit. In such instance it was found that a heater of approximately 13 watts provided the desired temperature increase with the corona charging voltage operating in the range between 9,000 to 13,000 volts, as measured from the positive to the negative terminals of the corona high voltage power supply, that is, the total voltage from corona wires 14 to corona wires 17 in FIG. 1. The improved operation with regard to streaking appeared to be somewhat enhanced with the corona unit charging voltage preferably being maintained in the voltage range between 12,200 to 12,800 volts, again as measured from the positive to the negative terminals of the corona power supply.

The heating effect of the heating unit on the ultimate visible image produced in a copier apparatus is related to the speed of the paper which is moving through the corona charging unit as well as to the type of paper being used, that is, the type of photoconductive coating and conductive backing of which the electro-photographic plate is made. Thus, the faster the travel of paper through the corona charging unit the higher the wattage of the heater selected. It is well within the purview of those in the art to select the heater configuration and wattage to satisfy the characteristics of paper speed and paper structure to produce the streak elimination effect as desired.

In some apparatus where it has been found desirable to utilize a pre-exposure system, as discussed above, the invention may be found to be even more useful since pre-exposure has a

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tendency to increase the streaking effect. FIG. 2 shows a pre-exposure lamp unit utilized in conjunction with a conventional corona charging unit 10 wherein an additional housing 30 is attached to corona charging unit housing 11. Housing 30 has an appropriate pre-exposure lamp 31 mounted therein for providing a pre-exposure of the coated paper prior to charging. As shown in the figure, light from lamp 31 is directed by the curved reflecting surface 32 within housing 31 upwardly through a slotted opening 33 toward the coated side of the electro-photographic plate. Without heating, such a structure produces significantly more streaking problems than a conventional apparatus not utilizing a pre-exposure step. However, streaking in such structure has been virtually eliminated by utilizing a resistance heating unit mounted on the side panel 34 of housing 11 opposite to the side panel on which the pre-exposure lamp is mounted in substantially the same manner as shown with reference to FIG. 1. Alternatively, it has been found that the use of a resistance heating unit may be avoided if an appropriate lamp is selected so as to provide sufficient light for pre-exposure and also sufficient heat to raise the temperature of the overall corona unit to the levels required to eliminate streaking. The selection of a lamp is well within the skill of those in the art under the principles discussed above with reference to this invention.

A further alternative embodiment of the invention using the heating effect that can be produced by the corona wires themselves is shown in FIG. 3. In the figure the pair of corona wires 14, for example, (only one of which is shown) are depicted as connected in the usual manner to one terminal, in this case the negative terminal, of a corona high voltage power supply 35. Similarly, the pair of corona wires 17 (only one of which is shown) are depicted as connected to the opposite terminal, in this case the positive terminal, of high voltage supply 35. In addition, however, an a-c voltage which, for example, may be obtained from a conventional 110V. a-c line voltage source 34, readily available in the copier apparatus, has a portion thereof tapped off via a secondary of a transformer 37, the value of the secondary voltage being in a range, for example, from 6 volts to 12 volts. Such secondary voltage is then connected across the end points of one of the corona wires of the pair 14 and causes a heating effect thereof which in no way interferes with the normal corona excitation effect. The use of such a localized heating effect at the corona wire itself would appear to permit the use of a lower temperature rise for the overall unit than that which is needed when an external heating source is used. The localized heating also may be achieved by applying such low a-c voltage to more than one of the corona wires by the use of appropriate circuitry.

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A further alternative embodiment is shown in FIGS. 4 and 5 wherein the housing 11 has a slot 38 provided in side panel 21 thereof, such slot being enclosed by a duct 39 which is suitably mounted on side panel 21 as shown. A tube 40 is mounted on duct 39 opposite an opening 41 in the wall 42 of duct 39. Tube 40 is connected to a suitable hot air supply 44 which provides heated air to the corona charging unit through slot 38 via duct 39 to provide the desired temperature rise for eliminating streaking. The heated air is thus conveyed into the interior of housing 11 and passes outwardly therefrom through upper and lower slots 12 and 13, respectively. The heated air may be obtained from a heater and fan arrangement appropriately mounted within the apparatus or from a heated region of the apparatus, such as the drier station, for example, normally available in a copier machine.

Other alternative embodiments utilizing the principle of heating the corona unit so as to avoid the streaking problem will occur to those in the art within the scope of the invention. Hence, the invention is not to be limited except as defined by the appended claims.

What is claimed is:

1. A corona charging unit for use in an electro-photographic copier apparatus and located at a position adjacent an exposure station thereof, said unit comprising
 - a housing structure having means for permitting an electro-photographic plate to be moved therethrough;
 - corona charging wires positioned in said housing structure so as to be adjacent opposite sides of said electro-photographic plate as it moves through said unit;
 - power supply means for supplying voltage to said corona charging wires for charging the photoconductive surface of said plate substantially immediately prior to exposure in said copier apparatus;
 - an opening provided in said housing structure;
 - duct means mounted on said housing structure so as to enclose said opening for conveying heated air through said opening into the interior of said housing structure; and
 - means for supplying heated air to said duct means for heating said corona charging unit to a temperature above its normal operating temperature simultaneously with the charging of said photoconductive surface for eliminating streaking of a visible image obtained on said electro-photographic plate during operation of said copier apparatus.
2. A corona charging unit in accordance with claim 1, wherein said opening is formed as an elongated slot along one side of said housing structure.

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